```
+--------------------------------------+---------------------------+
|EEEEE  RRRRR  RRRRR   AAA  TTTTT  AAA  | ERRATA No: EL00103-05NRO01|
|E      R   R  R   R  A   A   T   A   A |                           |
|EEE    RRRR   RRRR   AAAAA   T   AAAAA |                           |
|E      R  R   R  R   A   A   T   A   A +---+---+---+---+---+---+---+
|EEEEE  R   R  R   R  A   A   T   A   A | d | i | g | i | t | a | l |
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```

Orig.: Peter Boers Sheet: 1 of 2

Phone: 223-5452

Loc.: MLO6-1/U30 Date: 25-Nov-1992

Cost Center Y31 Issue Date: 25-Nov-1992

Documentation Affected: A-DS-EL00103-05-00-A
DEC STD 103-5 Electromagnetic Compatibility (EMC)
-- Hardware Design Requirements for
Electrostatic Discharge (ESD) Immunity Rev A
A-MN-ELSM114-01-00-S
EL-SM114-01 Mechanical Design Standards and Related
Documents - Volume 1

PROBLEM Typographical error appeared in subhead 1.6 General Laboratory Conditions, showing the minimum atmospheric pressure for ESD testing to be 860 mBar.

CORRECTION The correct minimum value is 680 mBar.

DESCRIPTION The text will be updated to correct the value of the lower limit.

EFFECTIVE Immediately

APPROVAL NAMES		C/C	Phone No. DTN-Ext.	Date dd-Mmm-yyyy
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W.O. No: 192972 Class: EL

ERREL00103-05NRO01

ITEM No.	PART NUMBER	DOCUMENT NUMBER	OLD REV	NEW REV
1	EL-00103-05	A-DS-EL00103-05-0	A	A

DESCRIPTION: Subhead 1.6 General Laboratory Conditions will read as follows:

Electrostatic Discharge (ESD) tests shall be performed under general available laboratory environmental conditions. The actual conditions shall be noted in the test report.

Temperature	15° to 35° C
Relative Humidity	30 to 60%
Pressure	680 to 1060 Mbar

EFFECTIVE: Immediately

DEC STD 103-5 Electromagnetic Compatibility (EMC) —Hardware Design Requirements for Electrostatic Discharge (ESD) Immunity

DOCUMENT IDENTIFIER: A-DS-EL00103-05-0000 Rev A, 01-Oct-1992

ABSTRACT: This standard defines the limits of electrostatic discharge effects on Digital's enclosure level hardware products. The standard also outlines measurement methodology, acceptance criteria, and responsibilities. After providing an overview of the subject, the standard describes the technical and internal reporting requirements of electrostatic discharge immunity.

APPLICABILITY: The requirements of this standard are mandatory for all Digital enclosure level hardware products that have a first volume ship (FVS) on or after the release date of this standard. Devices and systems in volume manufacturing, approved to DEC STD 103-0 Rev B, heading 5, prior to the release date of this standard, do not have to be redesigned to meet the technical requirements of this revision prior to 01-Jan-1996. However, the test data may require reevaluation to determine the compliance level to various external regulatory requirements or standards, and products in this category may not qualify for a CE label.

This standard is based on EN50082 Part 1 *Electromagnetic Compatibility, Generic Immunity Standard, Part 1: Residential, Commercial, and Light Industry* and IEC 801 Part 2 *Electromagnetic Compatibility, Part 2: Electrostatic Discharge, Part 2: Electrostatic Discharge, 1988, 1991.*

STATUS: APPROVED 01-Oct-1992; use VTX SMC for current status.

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DEC STD 103-5 Electromagnetic Compatibility (EMC) —Hardware Design Requirements for Electrostatic Discharge (ESD) Immunity

DOCUMENT IDENTIFIER: A-DS-EL00103-05-0000 Rev A, 01-Oct-1992

REVISION HISTORY:

Rev A, 01-Oct-1992

Document Management Category:	Electromagnetic Compatibility (HRC)
Responsible Department:	Low End Regulatory Engineering
Responsible Person:	Peter Boers
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APPROVAL: This document has been reviewed and recommended for approval by the General Review group for its category.

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1 INTRODUCTION

This standard defines immunity test requirements for electronic equipment intended for use in light industrial, commercial, and residential environments in relation to electrostatic discharges.

These requirements specifically include third-party and buy-out products imported by Digital into Europe (the European Community [EC] and European Free Trade Association [EFTA] countries), as well as products designed and manufactured by Digital.

The test laboratory staff is responsible for determining the appropriate equipment under test (EUT) and system test configuration, as well as the appropriate test procedures.

1.1 SCOPE

This standard for immunity applies to electrical and electronic equipment designed or sold by Digital that is intended for use in light industrial, commercial, and residential environments.

The requirements intended for equipment installed in heavy industrial locations are not identified in this document.

To meet the requirements for the CE mark, compliance to *DEC STD 103-3 Electromagnetic Compatibility (EMC)—Electromagnetic Interference (EMI) Requirements* and *DEC STD 103-4 Electromagnetic Compatibility (EMC)—Electromagnetic Susceptibility (Immunity)* is also required.

1.2 IMPLEMENTATION

The requirements of this standard are effective as of the approval date of this standard.

The documentation, calibration, and procedural requirements of other sections of *DEC STD 103 Electromagnetic Compatibility (EMC)* also apply.

1.3 WAIVERS

Where the requirements of this standard impose an unreasonable burden for the product, and the requirements are under the Digital proprietary section of this document, the engineering group may seek a waiver to these requirements.

Requests for such a waiver must be substantiated with a problem statement, cost, and time estimates to correct the problem, and must be agreed to by the EMC group, Manufacturing, Digital Services, and the EMC domain manager.

Products under waiver may not be acceptable for sale in Europe and may require changes on the product label (or have the CE label removed) to indicate that the products under waiver do not meet legal requirements for sale in certain geographical areas.

1.4 PRODUCT TEST DOCUMENTATION

Qualification tests will be documented in sufficient detail to allow the test to be repeated, based on the test report information. Qualification reports will be mailed to the EMC domain office for archiving, for obtaining product approvals from outside regulatory agencies, and as a basis for issuing declarations of compliance. Suggested formats for data sheets are included in the appendices to this document.

Further requirements are listed in *DEC STD 103-1 Electromagnetic Compatibility (EMC) - Documentation and Approval Process.*

1.5 PERFORMANCE CRITERIA

The categories listed in Table 1 represent the test performance criteria.

Table 1: Performance Criteria

A	The apparatus, system, or device under test shall continue to operate as intended. No degradation of performance, loss of function, or loss of data is allowed.
B	The apparatus, system, or device under test shall continue to operate as intended after the test. Performance may be degraded during the test; however, no loss of data, erroneous data, or functions may occur during the test. Full performance is restored automatically after the test without the need for any operator or user intervention.
C	Temporary loss of function during the test is allowed, provided the functions are self-recoverable or can be restored by the operator. If permanent loss of data occurs, the operator must receive an indication that such has happened.

1.6 GENERAL LABORATORY CONDITIONS

Electrostatic Discharge (ESD) tests shall be performed under general available laboratory environmental conditions. The actual conditions shall be noted in the test report.

Temperature	15° to 35°C
Relative humidity	30 to 60%
Pressure	860 to 1060 mBar

1.7 QUALITY ASSURANCE REQUIREMENTS

Products that receive approval for First Revenue Ship (FRS) on or after 01-Jan-1994 must incorporate the requirements of this standard as part of any audit plans as described in *DEC STD 103-7 Electromagnetic Compatibility (EMC) - Quality Process*. The audit plan includes physical inspection to a Critical Features List (CFL) instead of, or in addition to, testing.

2 LIMITS

The test level as shown in Table 2 is applicable for ESD testing.

The EUT shall be exposed to at least 200 contact discharges and 40 air discharges each at negative and positive polarity, distributed over a minimum of four test points.

If no particular differences are noted in sensitivity to either positive or negative polarity, the ESD event shall be evenly distributed between positive and negative polarity. Otherwise, the worst-case polarity shall be used for testing.

On those parts of the EUT where it is not possible to perform contact discharge testing, the product should be investigated to identify user accessible points where breakdown may occur. Examples are openings at edges of keys or in the covers of keyboards. Such points are tested using the air discharge method. This investigation should be restricted to those areas normally handled by the user. Ten single air discharges shall be applied to the selected test point for each such area. Contacts of open connectors are excluded from ESD testing.

Table 2: Test Levels

Contact Discharge	Air Discharge	Test Criteria
2 kV	up to 10 kV	Performance criteria A Must maintain normal operating conditions
3 kV	up to 12 kV	Performance criteria B Self-restoring
4 kV	up to 15 kV	Performance criteria C No permanent equipment damage

NOTE

Air discharge testing shall be performed at all the levels 2, 4, 6, 8, 10, 12, and 15 kV.

The contact discharge test levels are intended to simulate environmental conditions that are higher than the voltage levels described.

3 GENERAL CONDITIONS

The following subheads describe the general conditions for testing.

3.1 DOCUMENTATION

Testing shall be performed according to a written, product-specific test plan. In combination with the test plan and the results obtained during the qualification testing, a test report shall be written at the conclusion of the test. This test plan should include the following.

- Part number and equipment type or other description of the EUT
- Representative operating conditions under which the EUT is to be tested, including any software programs used to monitor the operating conditions and performance of the EUT
- Statement whether the EUT should be tested as tabletop or floorstanding
- Any support equipment used to facilitate operating the EUT

- Statement whether indirect application to the HCP or VCP is required, and the positions of coupling plane(s), if applicable
- For each test point, whether contact or air discharges are to be applied, the polarity, and the number of test discharges
- Time and place where the testing was done
- Person or persons performing the tests
- Serial numbers, if any, of the device(s) being tested or used in the operational support of the EUT
- Identification of the test equipment and its last calibration date
- Any other information that is required to repeat the test
- Deviations or additions (if any) to the test plan
- Assessment of the EUT with respect to the test plan and this standard

In addition, the test report shall meet the general criteria of ISO Guide 45, *Guidelines for the Presentation of Test Reports*. See also DEC STD 103-1.

3.2 DIRECT APPLICATION OF STATIC DISCHARGES TO THE EUT

The static electricity discharges shall be applied only to such points and surfaces of the EUT that are accessible to customer personnel during normal operation, such as loading of tapes.

Testing shall be performed with single discharges on points defined in the test plan. The time interval between discharges shall be at least 1 second.

NOTE

The selection of these points may be done based on exploratory testing with discharge repetition rates as fast as 20 pulses per second.

The ESD generator shall be held or mounted perpendicular to the surface to which the discharges are applied. If the ESD generator is fitted with a discharge return cable, this cable shall be positioned at least 0.2 m from any EUT point. The testing is not valid if the position of this cable influences the test results by more than 10%.

Contact discharge testing
The tip of the discharge electrode shall touch the EUT before the discharge takes place. Paint coatings may be penetrated by the tip of the tester if this coating breaks down under the equivalent air discharge voltage for the specific test.

Air discharge testing
The round tip of the discharge electrode shall approach the EUT as fast as possible to touch the EUT without causing mechanical damage. After each discharge, the ESD tester shall be removed from the EUT. This process is repeated for the required number of discharges.

3.3 INDIRECT APPLICATION OF STATIC DISCHARGES TO THE EUT

Indirect application of static discharges is only applicable if the EUT is made of nonconductive material, or insulated in such a way that no direct discharges can be made to one or more of the surfaces of a EUT. Only those surfaces (except for the bottom surface) to which no direct discharge can be made are potentially subject to indirect discharges.

The bottom surface of a device is always subject to an indirect discharge test.

Horizontal and vertical coupling plane tests are potentially applicable to tabletop EUTs.

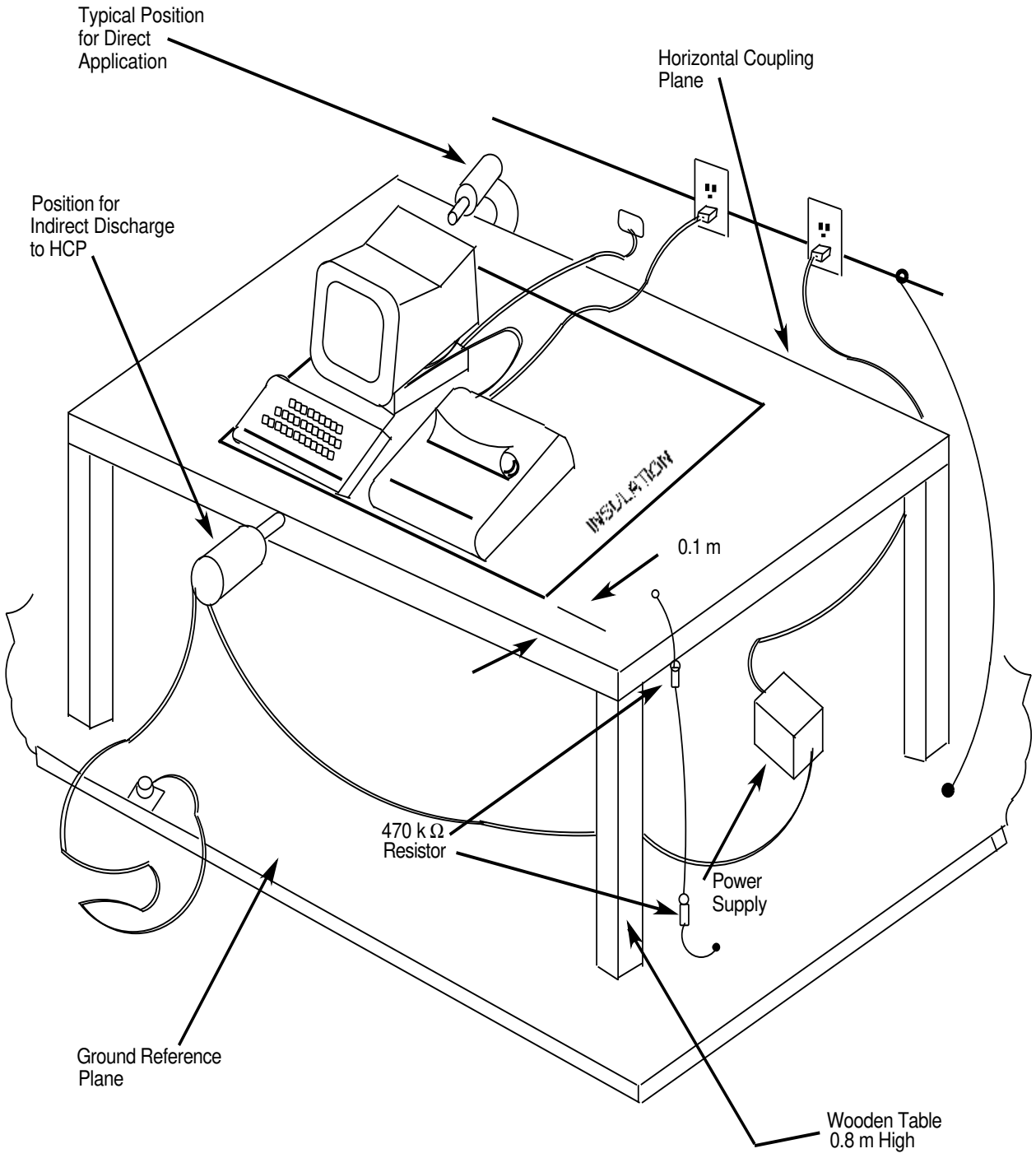
Only the vertical coupling test is potentially applicable to floorstanding EUTs.

In addition, the requirements for direct discharges apply.

3.4 HORIZONTAL COUPLING PLANE UNDER THE EUT

At least 50 discharges shall be applied to the front edge of the horizontal coupling plane (see Figure 1). The ESD tester shall be positioned horizontally with the discharge electrode touching the edge of the coupling plane.

Figure 1: Example of the Test Setup for Tabletop Equipment, Laboratory Tests



3.5 EQUIPMENT-SPECIFIC CONDITIONS

To be determined

4 TEST SETUP

The test setup consists of the test generator, EUT, and auxiliary instrumentation necessary to perform direct and indirect application of discharges to the EUT, as applicable, in the following manner.

a. Contact discharge to the conductive surfaces and to coupling planes

b. Air discharge at insulating surfaces

The test conditions of IEC 801 Part 2 *Electromagnetic Compatibility, Part 2: Electrostatic Discharge, 1988, 1991* for equipment setup apply.

Two different types of tests can be distinguished.

— Type tests performed in laboratories

— Post-installation tests performed on equipment in the final installed conditions

Type tests performed in laboratories are the preferred test method, and the only accepted method of demonstrating compliance with this standard. The EUT shall be arranged as closely as possible to the arrangement in the final installed conditions.

4.1 TEST SETUP FOR TESTS PERFORMED IN LABORATORIES

The following requirements apply to tests performed in laboratories under environmental reference conditions outlined in subhead 1.6.

A ground reference plane (GRP) shall be provided on the floor of the laboratory. It shall be a metallic sheet (copper or aluminum) of 0.25 mm minimum thickness; other metallic materials may be used but they shall have at least 0.65 mm minimum thickness. The minimum size of the GRP is 1 square meter, the final size depending on the dimensions of the EUT. It shall project beyond the EUT or coupling plane at least 0.5 m on all sides, and shall be connected to the protective grounding system. Local safety regulations must always be met.

The EUT shall be arranged and connected according to its functional requirements. A distance of 1 m minimum shall be provided between the EUT and the walls of the laboratory and any other metallic structure.

The EUT shall be connected to the grounding system, in accordance with its installation specifications. No additional grounding connections are allowed.

The positioning and length of the power and signal cables shall be representative of installation practice.

The discharge return cable of the discrete storage-capacitance ESD generator shall be connected to the GRP. The total length of this cable is 2 m, in general.

In cases where this length exceeds the length necessary to apply the discharges to the selected points, the excess length shall, where possible, be placed noninductively off the GRP and shall not come closer than 0.2 m to other conductive parts in the test setup.

The connection of the cables to the GRP and all bondings shall be of low impedance, for example, by using clamping devices for high frequency applications.

Where coupling planes are specified, for example, to allow indirect application of the discharge, they shall be constructed from the same material, type, and thickness as for the GRP. They shall also be connected to the GRP by a strap with a 470 kohm resistor located at each end.

Additional specifications for the different types of equipment are given below.

Tabletop Equipment
The test setup shall consist of a wooden table, 0.8 m high, standing on the GRP. A horizontal coupling plane (HCP), 1.6 m $\times$ 0.8 m, shall be placed on the table. The EUT and cables shall be isolated from the HCP by an insulating support 0.5 mm thick.

If the EUT is too large to be located 0.1 m minimum from all sides of the HCP, an additional, identical HCP shall be used, placed 0.3 m from the first, with the short sides adjacent. The table may be enlarged or two tables may be used. The HCPs shall not be bonded together, other than using the resistive straps to the GRP.

Any mounting feet associated with the EUT shall remain in place.

An example of the test setup for tabletop equipment is given in Figure 1.

Floorstanding Equipment
The EUT and cables shall be isolated from the GRP by an insulating support about 0.1 m thick.

An example of the test setup for floorstanding equipment is given in Figure 2.

Any mounting feet associated with the EUT shall remain in place.

4.2 EUT OPERATING CONDITIONS

The EUT shall be operated normally to allow a correct evaluation of immunity. Test programs and software shall be chosen to exercise all normal modes of operation of the EUT. The use of special exercising software is encouraged, provided it can be shown that the EUT is comprehensively exercised in its normal operating modes. For compliance testing, the EUT shall be continually operated in its most sensitive mode (program cycle) which shall be determined by pretesting.

The recognition of functional disturbances shall be made possible by the use of suitable monitoring equipment. It should be noted that the direct connection of external monitoring equipment to circuit parts of the EUT can falsify the test results.

To obtain reproducible results, the EUT shall be decoupled from its driving and monitoring equipment as far as possible (for example, by their removal to a separate shielded room).

If such arrangements are not available, it must be ensured that the measurement and monitoring equipment are sufficiently immune to the effects of the adjacent ESD tester, or to conducted effects through the mains supply.

For visual display units, the pattern for emission testing can be used. Scrolling is recommended. If graphics are supported, alternating vertical lines, concentric, or stonewall patterns may be more appropriate.

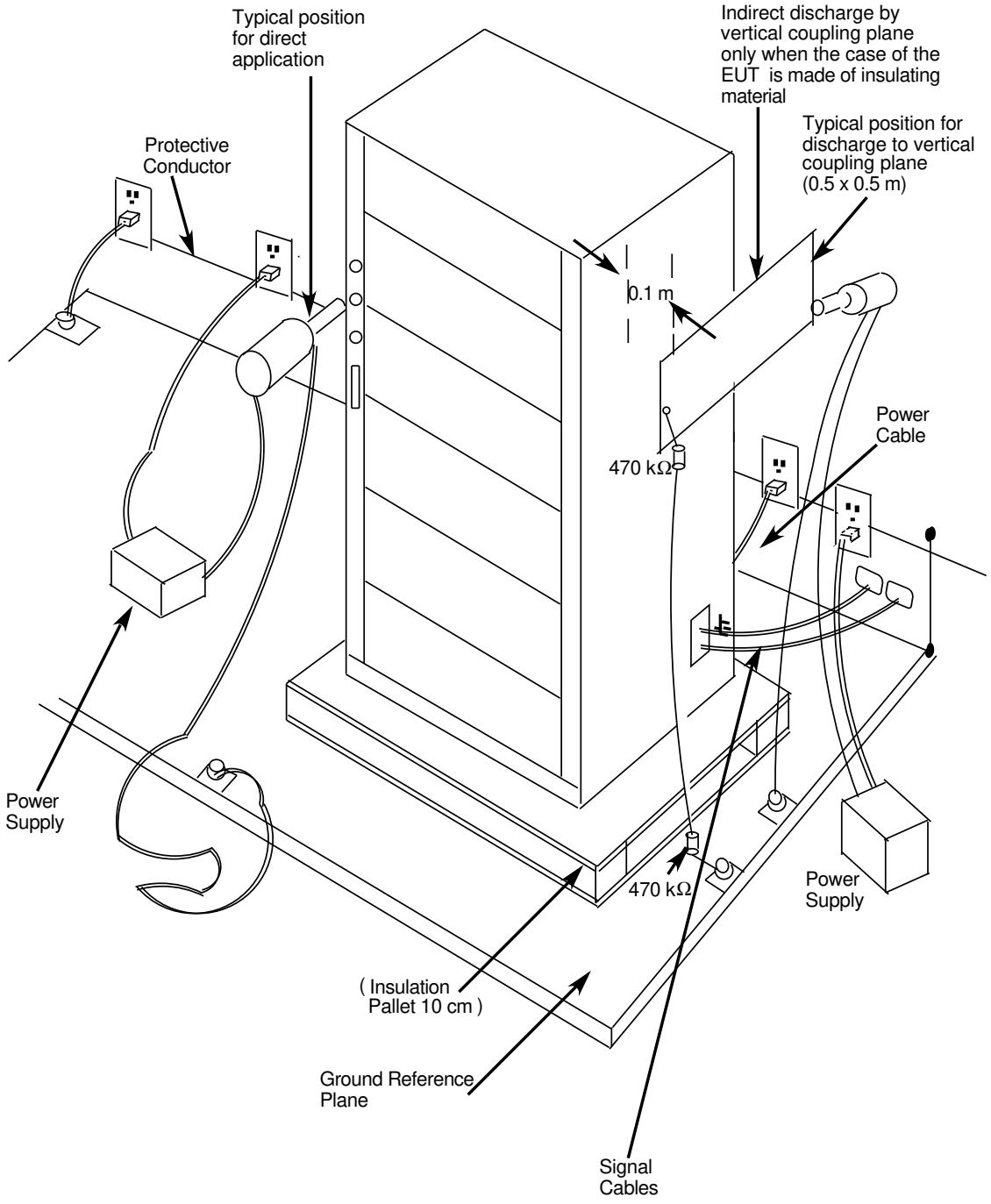
For printer testing, the alphanumeric pattern already specified for visual display units can be used. For plotter testing, a grid with horizontal and vertical lines, diagonal lines, circles, or combinations of these can be used.

Hard copy devices usually have built-in routines that often satisfy the test program requirements.

Mass storage devices are tested with alternating write and read cycles, comparing the retrieved information with memory.

Central processing units may perform sorting, retrieval, computation, or a combination of these. Results of the manipulations are to be compared against previous results. All of the information mentioned previously shall be documented in the test report. Suitable photographs, line drawings, or sketches may be appropriate.

Figure 2: Example of Test Setup for Floorstanding Equipment, Laboratory Tests


Typical position for direct application
Indirect discharge by vertical coupling plane only when the case of the EUT is made of insulating material
Typical position for discharge to vertical coupling plane (0.5 x 0.5 m)
Protective Conductor
0.1 m
Power Cable
470 kΩ
Power Supply
470 kΩ
Power Supply
(Insulation Pallet 10 cm)
Ground Reference Plane
Signal Cables

APPENDIX A TEST DATA SHEETS

A test data sheet that can be used for recording test results described in this standard is on the following page.

An immunity test report must contain this sheet (or similar), properly filled out and signed by the person(s) performing the tests.

Test numbers are to be assigned using the first 3 characters that indicate the test facility site code and a 6-digit numerical sequence assigned by the test facility for that specific test.

A product immunity test report can only refer to *one* test sequence number for each test item, and a compliance report can only cover one specific identifiable EUT.

Test date:	Test facility/number /	Page of
Test type: Electrostatic discharges, DEC STD 103–5		
Performance criteria: [A] No failure [B] Self restoring [C] Restart Test level (1 or 2) [1]		
EUT description: S/N: Diagnostic SW: [P] = pass [D] = degraded but self–restoring [F] = Fail		Temp. ^{o}C RH % Pressure in Bar

Test equipment	S/N:	Calibration date
ESD generator:		
:		

Test Point on EUT	Contact or Air	ESD gen. setting kV	Performance criteria A/B/C	Result P/D/F	Notes

Tested by:	Continuation sheet page [ ]
Notes	

APPENDIX B REFERENCED DOCUMENTS

B.1 EL-Class Digital Documents

EL-Class Number	Document Title
EL-00103-00	*DEC STD 103-0 Electromagnetic Compatibility (EMC) - Overview and Process Requirements*
EL-00103-01	*DEC STD 103-1 Electromagnetic Compatibility (EMC) - Documentation and Approval Process*
EL-00103-03	*DEC STD 103-3 Electromagnetic Compatibility (EMC) - Electromagnetic Interference (EMI) Requirements*
EL-00103-04	*DEC STD 103-4 Electromagnetic Compatibility (EMC) —Electromagnetic Susceptibility (Immunity)*
EL-00103-07	*DEC STD 103-7 Electromagnetic Compatibility (EMC) - Quality Process*

Use VTX SMC to order copies of EL-class documents from Standards and Methods Control. Send distribution questions to JOKUR::SMC or call DTN: 234-4423.

B.2 Other Documents

Document Number	Document Title
EN50082 PART 1	*Electromagnetic Compatibility, Generic Immunity Standard, Part 1: Residential, Commercial, and Light Industry*
IEC 801 PART 2	*Electromagnetic Compatibility, Part 2: Electrostatic Discharge, Part 2: Electrostatic Discharge, 1988, 1991*
ISO GUIDE 45	*Guidelines for the Presentation of Test Reports*

B.3 Ordering Information

Copies of documents not available from Standards and Methods Control can be obtained from the EMC domain office.

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